

EXHIBIT 2

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**Recommended
Standards
For Water Works**

2003 Edition

Policies for the Review and Approval
of Plans and Specifications for Public Water Supplies

A Report of the Water Supply Committee of the
Great Lakes--Upper Mississippi River Board
of State and Provincial Public Health and Environmental Managers

MEMBER STATES AND PROVINCE

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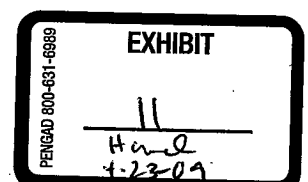
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FOREWORD

The Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers in 1950 created a Water Supply Committee consisting of one associate from each state represented on the Board. A representative from the Province of Ontario was added in 1978. Throughout this document the term state shall mean a representative state or the Province of Ontario. The Committee was assigned the responsibility for reviewing existing water works practices, policies, and procedures, and reporting its findings to the

Board. The report of the Water Supply Committee was first published in 1953, and subsequently has been revised and published in 1962, 1968, 1976, 1982, 1987, 1992, 1997, and 2003.

This document includes the following:

1. Policy Statements - Preceding the standards are policy statements of the Board concerning water works design, practice, or resource protection. Some policy statements recommend an approach to the investigation of innovative treatment processes which have not been included as part of the standards because sufficient confirmation has not yet been documented to allow the establishment of specific limitations or design parameters. Other policy statements recommend approaches, alternatives or considerations in addressing a specific water supply issue and may not develop into standards.
2. Interim Standards - Following the policy statements are interim standards. The interim standards give design criteria which are currently being used for new treatment processes, but the use of the criteria is limited and insufficient for recognition as a recommended standard.
3. Recommended Standards - The Standards, consisting of proven technology, are intended to serve as a guide in the design and preparation of plans and specifications for public water supply systems, to suggest limiting values for items upon which an evaluation of such plans and specifications may be made by the reviewing authority, and to establish, as far as practicable, uniformity of practice. Because statutory requirements and legal authority pertaining to public water supplies are not uniform among the states, and since conditions and administrative procedures and policies also differ, the use of these standards must be adjusted to these variations.

The terms shall and must are used where practice is sufficiently standardized to permit specific delineation of requirements or where safeguarding of the public health justifies such definite action. Other terms, such as should, recommended, and preferred, indicate desirable procedures or methods, with deviations subject to individual consideration.

Most quantified items in this document are cited in US customary units and are rounded off at two significant figures. Metric equivalent quantities, also rounded off at two significant figures, follow in brackets where compound units are involved. The metric unit symbols follow

International System conventions. In the event of a conflict between quantities in US units and the metric equivalent the quantity in US units shall take precedence.

It is not possible to cover recently developed processes and equipment in a publication of this type. However, the policy is to encourage, rather than obstruct, the development of new processes and equipment. Recent developments may be acceptable to individual states if they meet at least one of the following conditions: 1) have been thoroughly tested in full scale comparable installations under competent supervision, 2) have been thoroughly tested as a pilot plant operated for a sufficient time to indicate satisfactory performance, or 3) a performance bond or other acceptable arrangement has been made so the owners or official custodians are adequately protected financially or otherwise in case of failure of the process or equipment.

The Board recognizes that many states, other than those of the Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, utilize this publication as part of their design requirements for water works facilities. The Board welcomes this practice as long as credit is given to the Board and to this publication as a source for the standards adopted. Suggestions from non-member states are welcome and will be considered.

Adopted April, 1997

POLICY STATEMENT ON PRE-ENGINEERED WATER TREATMENT PLANTS

Pre-engineered water treatment plants are becoming available and being used for production of potable water at public water systems. Many applications being proposed are for small systems having relatively clean surface water sources which are now being required to provide filtration under the federal Safe Drinking Water Act.

Pre-engineered water treatment plants are normally modular process units which are pre-designed for specific process applications and flow rates and purchased as a package. Multiple units may be installed in parallel to accommodate larger flows.

Pre-engineered treatment plants have numerous applications but are especially applicable at small systems where conventional treatment may not be cost effective. As with any design the proposed treatment

must fit the situation and assure a continuous supply of safe drinking water for water consumers. The reviewing authority may accept proposals for pre-engineered water treatment plants on a case by case basis where they have been demonstrated to be effective in treating the source water being used.

Factors to be considered include:

1. Raw water quality characteristics under normal and worst case conditions. Seasonal fluctuations must be evaluated and considered in the design.
2. Demonstration of treatment effectiveness under all raw water conditions and system flow demands. This demonstration may be on-site pilot or full scale testing or testing off-site where the source water is of similar quality. On-site testing is required at sites having questionable water quality or applicability of the treatment process. The proposed demonstration project must be approved by the reviewing authority prior to starting.
3. Sophistication of equipment. The reliability and experience record of the proposed treatment equipment and controls must be evaluated.
4. Unit process flexibility which allows for optimization of treatment.
5. Operational oversight that is necessary. At surface water sources full-time operators are necessary, except where the reviewing authority has approved an automation plan. See Policy Statement on Automated/Unattended Operation of Surface Water Treatment Plants.
6. Third party certification or approvals such as National Sanitation Foundation (NSF) for a) treatment equipment and b) materials that will be in contact with the water.
7. Suitable pretreatment based on raw water quality and the pilot study or other demonstration of treatment effectiveness.
8. Factory testing of controls and process equipment prior to shipment.
9. Automated troubleshooting capability built into the control system.

10. Start-up and follow-up training and troubleshooting to be provided by the manufacturer or contractor.

11. Operation and maintenance manual. This manual must provide a description of the treatment, control and pumping equipment, necessary maintenance and schedule, and a troubleshooting guide for typical problems.

12. On-site and contractual laboratory capability. The on-site testing must include all required continuous and daily testing as specified by the reviewing authority. Contract testing may be considered for other parameters.

13. Manufacturers warranty and replacement guarantee. Appropriate safeguards for the water supplier must be included in contract documents. The reviewing authority may consider interim or conditional project approvals for innovative technology where there is sufficient demonstration of treatment effectiveness and contract provisions to protect the water supplier should the treatment not perform as claimed.

14. Water supplier revenue and budget for continuing operations, maintenance and equipment replacement in the future.

Additional information on this topic is given in the State Alternative Technology Approval Protocol dated June, 1996 which was developed by the Association of State Drinking Water Administrators, U.S. Environmental Protection Agency and various industry groups.

Adopted April, 1997

POLICY STATEMENT ON CONTROL OF ORGANIC CONTAMINATION FOR PUBLIC WATER SUPPLIES

Although standards and advisories for organics are being developed, there have been numerous cases of organic contamination of public water supply sources. In all cases, public exposure to organic contamination must be minimized. There is insufficient experience to establish design standards which would apply to all situations. Controlling organic contamination is an area of design that requires pilot studies and early consultation with the reviewing authority. Where treatment is proposed, best available technology shall be provided to

reduce organic contaminants to the lowest practical levels. Operations and monitoring must also be considered in selecting the best alternative. The following alternatives may be applicable:

1. Alternate Source Development
2. Existing Treatment Modifications
3. Air Stripping For Volatile Organics (See 4.5.4 Packed Tower Aeration)
4. Granular Activated Carbon

Consideration should be given to:

- a. using contact units rather than replacing a portion of existing filter media;
- b. series and parallel flow piping configurations to minimize the effect of breakthrough without reliance on continuous monitoring;
- c. providing at least two units. Where only two units are provided, each shall be capable of meeting the plant design capacity (normally the projected maximum daily demand) at the approved rate. Where more than two units are provided, the contactors shall be capable of meeting the design capacity at the approved rate with one or more (as determined in conjunction with the reviewing authority) units removed from service;
- d. using virgin carbon; this is the preferred media. Although reactivated carbon may eventually present an economic advantage at large water treatment plants, such an alternative may be pursued only with the preliminary endorsement of the reviewing authority. Regenerated carbon using only carbon previously used for potable water treatment can be used for this purpose. Transportation and regeneration facilities must not have been used for carbon put to any other use;
- e. acceptable means of spent carbon disposal.

Except for temporary, emergency treatment conditions, particular attention should be given to developing an engineering report which, in addition to the normal determinations, includes the following:

1. For organic contaminants found in surface water sources:

- a. type of organic chemicals, sources, concentration, frequency of occurrence, water pollution abatement schedule, etc.,
- b. possible existing treatment plant modifications to lower organic chemical levels. Results of bench, pilot or full scale testing demonstrating treatment alternatives, effectiveness and costs,
- c. a determination of the quality and/or operational parameters which serve as the best measurement of treatment performance, and a corresponding monitoring and process control program.

2. For organic contamination found in groundwater sources:

- a. types of organic chemicals, sources, concentration, estimate of residence time within the aquifer, plume delineation, flow characteristics, water pollution abatement schedule, etc.,
- b. results of bench or pilot studies demonstrating treatment alternatives, effectiveness, and costs,
- c. a determination of the quality and/or operational parameters which serve as the best measure of treatment performance, and a corresponding monitoring and process control program,
- d. development and implementation of a wellhead protection plan.

The collection of this type of data is often complicated and lengthy. Permanent engineering solutions will take significant time to develop. The cost of organic analyses and the availability of acceptable laboratories may further complicate both pilot work and actual operation.

Alternative source development or purchase of water from nearby unaffected systems may be a more expedient solution for contaminated groundwater sources.

Adopted April, 1987
Revised April, 1991
Revised April, 1997

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TREATMENT

- [4.0 GENERAL](#)
- [4.1 CLARIFICATION](#)
- [4.2 FILTRATION](#)
- [4.3 DISINFECTION](#)
- [4.4 SOFTENING](#)
- [4.5 AERATION](#)
- [4.6 IRON AND MANGANESE CONTROL](#)
- [4.7 FLUORIDATION](#)
- [4.8 STABILIZATION](#)
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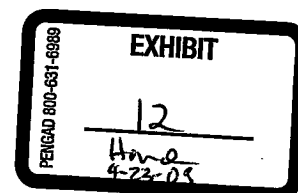
4.0 GENERAL

The design of treatment processes and devices shall depend on evaluation of the nature and quality of the particular water to be treated, seasonal variations, the desired quality of the finished water and the mode of operation planned.

4.1 CLARIFICATION

Plants designed to include clarification for processing surface water shall

- a. provide a minimum of two units each for rapid mix, flocculation and sedimentation,
- b. permit operation of the units either in series or parallel where softening is performed and *should* permit series or parallel operation where plain clarification is performed,
- c. be constructed to permit units to be taken out of service without disrupting operation, and with drains or pumps sized to allow dewatering in a reasonable period of time,
- d. provide multiple-stage treatment facilities when required by the reviewing authority,
- e. be started manually following shutdown,



concrete must be coated with a non-leaching protective coating which is compatible with salt and brine.

4.4.2.19 Housing

Bagged salt and Dry bulk salt storage shall be enclosed and separated from other operating areas in order to prevent damage to equipment.

4.4.3 Water quality test equipment

Test equipment for alkalinity, total hardness, carbon dioxide content, and pH should be provided to determine treatment effectiveness.

4.5 AERATION

Aeration may be used to help remove offensive tastes and odors due to dissolved gases from decomposing organic matter, or to reduce or remove objectionable amounts of carbon dioxide, hydrogen sulfide, etc., and to introduce oxygen to assist in iron and/or manganese removal. The packed tower aeration process is an aeration process applicable to removal of volatile organic contaminants.

4.5.1 Natural draft aeration

Design shall provide

- a. perforations in the distribution pan $\frac{3}{16}$ to $\frac{1}{2}$ inches in diameter, spaced 1 to 3 inches on centers to maintain a six inch water depth,
- b. for distribution of water uniformly over the top tray,
- c. discharge through a series of three or more trays with separation of trays not less than 12 inches,
- d. loading at a rate of 1 to 5 gallons per minute for each square foot of total tray area (2.5 - 12.5 m/hr),
- e. trays with slotted, heavy wire ($\frac{1}{2}$ inch openings) mesh or perforated bottoms,
- f. construction of durable material resistant to aggressiveness of the water and dissolved gases,

g. protection from loss of spray water by wind carriage by enclosure with louvers sloped to the inside at a angle of approximately 45 degrees,

h. protection from insects by 24-mesh screen.

4.5.2 Forced or induced draft aeration

Devices shall be designed to

a. include a blower with a weatherproof motor in a tight housing and screened enclosure,

b. insure adequate counter current of air through the enclosed aerator column,

c. exhaust air directly to the outside atmosphere,

d. include a down-turned and 24-mesh screened air outlet and inlet,

e. be such that air introduced in the column shall be as free from obnoxious fumes, dust, and dirt as possible,

f. be such that sections of the aerator can be easily reached or removed for maintenance of the interior or installed in a separate aerator room,

g. provide loading at a rate of 1 to 5 gallons per minute for each square foot of total tray area(2.5 - 12.5 m/hr),

h. insure that the water outlet is adequately sealed to prevent unwarranted loss of air,

i. discharge through a series of five or more trays with separation of trays not less than six inches or as approved by the reviewing authority,

j. provide distribution of water uniformly over the top tray,

k. be of durable material resistant to the aggressiveness of the water and dissolved gases.

4.5.3 Spray aeration

Design shall provide

- a. a hydraulic head of between 5 - 25 feet,
- b. nozzles, with the size, number, and spacing of the nozzles being dependent on the flowrate, space, and the amount of head available,
- c. nozzle diameters in the range of 1 to 1.5 inches to minimize clogging,
- d. an enclosed basin to contain the spray. Any openings for ventilation, etc. must be protected with a 24-mesh screen.

4.5.4 Pressure aeration

Pressure aeration may be used for oxidation purposes only if pilot plant study indicates the method is applicable; it is not acceptable for removal of dissolved gases. Filters following pressure aeration must have adequate exhaust devices for release of air. Pressure aeration devices shall be designed to

- a. give thorough mixing of compressed air with water being treated,
- b. provide screened and filtered air, free of obnoxious fumes, dust, dirt and other contaminants.

4.5.5 Packed tower aeration

Packed tower aeration (PTA) which is also known as air stripping involves passing water down through a column of packing material while pumping air counter-currently up through the packing. PTA is used for the removal of volatile organic chemicals, trihalomethanes, carbon dioxide, and radon. Generally, PTA is feasible for compounds with a Henry's Constant greater than 100 (expressed in atm mol/mol) - at 12EC), but not normally feasible for removing compounds with a Henry's Constant less than 10. For values between 10 and 100, PTA may be feasible but should be extensively evaluated using pilot studies. Values for Henry's Constant should be discussed with the reviewing agency prior to final design.

4.5.5.1 Process design

- a. Process design methods for PTA involve the determination of Henry's Constant for the contaminant, the mass transfer coefficient, air pressure drop and stripping factor. The applicant shall provide justification for the design parameters selected (i.e. height and

diameter of unit, air to water ratio, packing depth, surface loading rate, etc.). Pilot plant testing may be required.

The pilot test shall evaluate a variety of loading rates and air to water ratios at the peak contaminant concentration. Special consideration should be given to removal efficiencies when multiple contaminations occur. Where there is considerable past performance data on the contaminant to be treated and there is a concentration level similar to previous projects, the reviewing authority may approve the process design based on use of appropriate calculations without pilot testing. Proposals of this type must be discussed with the reviewing authority prior to submission of any permit applications.

b. The tower shall be designed to reduce contaminants to below the maximum contaminant level (MCL) and to the lowest practical level.

c. The ratio of the column diameter to packing diameter should be at least 7:1 for the pilot unit and at least 10:1 for the full scale tower. The type and size of the packing used in the full scale unit shall be the same as that used in the pilot work.

d. The minimum volumetric air to water ratio at peak water flow should be 25:1. The maximum air to water ratio for which credit will be given is 80:1.

e. The design should consider potential fouling problems from calcium carbonate and iron precipitation and from bacterial growth. It may be necessary to provide pretreatment. Disinfection capability shall be provided prior to and after PTA.

f. The effects of temperature should be considered since a drop in water temperature can result in a drop in contaminant removal efficiency.

g. Redundant capacity may be required by the reviewing authority.

4.5.5.2 Materials of construction

a. The tower can be constructed of stainless steel, concrete, aluminum, fiberglass or plastic. Uncoated carbon steel is not recommended because of corrosion. Towers constructed of light-weight materials should be provided with adequate support to prevent damage from wind.